**NATURAL RESOURCES CONSERVATION SERVICE**
**CONSERVATION PRACTICE SPECIFICATION**

# IRRIGATION WATER CONVEYANCE HIGH-PRESSURE, UNDERGROUND, PLASTIC PIPELINE

**(ft)**
**CODE 430DD**

## 1. SCOPE

The work shall consist of installing underground thermoplastic pipelines ranging from ½ through 27 inches in diameter, closed to the atmosphere, and subject to internal pressures of 50 pounds per square inch or greater for the purpose(s) listed in Conservation Practice Standard 430DD.

## 2. MATERIALS

**a. Quality of plastic pipe.** The compound used in manufacturing the pipe shall meet the requirements of one of the following materials:

**1. Polyvinyl chloride (PVC) as specified in ASTM-D-1784.**

| Material | Code classification |
|---|---|
| Type I, Grade 1 | 12454-B |
| Type I, Grade 2 | 12454-C |
| Type II, Grade 1 | 14333-D |

**2. Acrylonitrile-butadiene-styrene (ABS) as specified in ASTM-D-1788.**

| Material | Code classification |
|---|---|
| Type I, Grade 2 | 5-2-2 |
| Type I, Grade 3 | 3-5-5 |
| Type II, Grade 1 | 4-4-5 |

**3. Polyethylene (PE) as specified in ASTM-D-1248.**

| Material | Code classification |
|---|---|
| Grade P14, Class C | IC-P14 |
| Grade P23, Class C | IIC-P23 |
| Grade P33, Class C | IIIC-P33 |
| Grade P34, Class C | IVC-P34 |

The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign matter, or other defects. The pipe shall be as uniform in color, opacity, density, and other physical properties as is commercially practicable.

**b. Markings**. Markings on the pipe shall include the following, which shall be spaced at intervals of not more than 5 ft:

- Nominal pipe size (e.g., 2 in).
- Type of plastic pipe material, by designation code (e.g., PVC 1120).
- Pressure rating, psi, for water at $23^0$C ($73.4^0$F) (e.g., 160 psi).
- Manufacturer's name (or trademark) and code.
- Specification designation with which the pipe complies:

a. IPS-size pipe, the ASTM designation (e.g., D-2241). Pipe meeting one of the ASTM designations listed for IPS-size pipe and intended for the transport of potable water shall also be marked with the seal of a recognized laboratory making the evaluation for this purpose.

b. For plastic irrigation pipe, the designation PIP.

**c. Pipe requirements**. All pipe installed under this standard shall be pressure rated for water.

The relationship between standard dimension ratios, dimensions, hydrostatic design stresses, and pressure ratings shall be determined by one of the following formulas:

For PVC, ABS, and PE pipe with outside diameter controlled:

$2S/P = D_o/t - 1$ or $2S/P = R - 1$
For PE pipe with inside diameter controlled:
$2S/P = D_i/t + 1$ or $2S/P = R + 1$
Where:
S = hydrostatic design stress, psi.
P = pressure rating, psi.
$D_o$ = average outside diameter in inches.
$D_I$ = average inside diameter in inches.
t = minimum wall thickness in inches.
R = standard dimension ratio (SDR).
Hydrostatic design stresses for the plastic pipe material are given in **Table 1**.

**Table 1**
**Hydrostatic design stress and designation Plastic Pipe**

| Material | Hyd. Design Stress (psi.) | Designation on Pipe |
|---|---|---|
| **PVC Type I, Grade 1** | **2,000** | **PVC 1120** |
| **PVC Type I, Grade 2** | **2,000** | **PVC 1220** |
| **PVC Type II, Grade 1** | **1,000** | **PVC 2110** |
| **PVC Type II, Grade 1** | **1,250** | **PVC 2112** |
| **PVC Type II, Grade 1** | **1,600** | **PVC 2116** |
| **ABS Type I, Grade 2** | **800** | **ABS 1208** |
| **ABS Type I, Grade 2** | **1,000** | **ABS 1210** |
| **ABS Type I, Grade 3** | **1,600** | **ABS 1316** |
| **ABS Type II, Grade 1** | **1,250** | **ABS 2112** |
| **PE Grade P14** | **400** | **PE 1404** |
| **PE Grade P23** | **500** | **PE 2305** |
| **PE Grade P23** | **630** | **PE 2306** |
| **PE Grade P33** | **630** | **PE 3306** |
| **PE Grade P34** | **630** | **PE 3406** |
| **PE Grade P34** | **800** | **PE 3408** |

Iron pipe size (IPS) (outside diameter same as that for iron pipe sizes) and I.D. controlled PE pipe manufactured, tested, and marked to meet one of the following ASTM specifications shall be acceptable under this standard.

ASTM - Standard specification for-

D-1785 - Polyvinyl chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120;
D-2241 - Polyvinyl chloride (PVC) Plastic Pipe, (SDR-PR);
D-2672 - Bell-End Polyvinyl chloride (PVC) Plastic Pipe;
D-2740 - Polyvinyl chloride (PVC) Plastic Tubing;
D-1527 - Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80;
D-2282 - Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (SDR-PR);
D-2104 - Polyethylene (PE) Plastic Pipe, Schedule 40;
D-2239 - Polyethylene (PE) Plastic Pipe, (SDR-PR);
D-2447 - Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, based on outside diameter;
D-2737 - Polyethylene (PE) Plastic Tubing;
D-3035 - Polyethylene (PE) Plastic Pipe, (SDR-PR), Based on controlled outside diameter;
F-771 - Polyethylene (PE) Thermoplastic High-Pressure Irrigation Pipeline Systems;

Plastic irrigation pipe (PIP) shall meet the requirements of ASTM-D-2241 or of ASTM-D-2282 except that:

- The sustained pressure test shall not be required.
- The burst pressure tests shall be performed according to the procedures listed in ASTM-D-2241 or D-2282 and shall meet the applicable requirements given in these ASTM's or those listed below for the standard dimension ratios (SDR's) currently not included in ASTM-D-2241 or D-2282.

The minimum burst pressure requirements for water at $23^0$C ($73.4^{0\ F)}$ for PVC 1120 and PVC 1220 plastic pipe for SDR 51 is 260 psi. The design stress levels used for the test pressures are: PVC 1120 and 1220 – 6,400 psi.

Burst pressure requirements for water at $23^0$ C ($73.4^0$ F) for ABS[1] plastic pipe are:

| SDR | Minimum burst pressure | |
|---|---|---|
| | ABS 2112 | ABS 1316 |
| **32.5** | **420 psi.** | **380 psi** |
| **41** | **-** | **300 psi** |

[1]The fiber stresses used to drive these test pressures are: ABS 2112-6,600 psi; ABS 1316-6,000 lb/in$^2$. To simplify testing, minor adjustments have been made to keep the test pressures uniform.

**Table 2**
**Pressure rating factors for PVC and PE pipe for water at elevated temperatures**

| Temperature deg F | PVC Factor | PE Factor |
|---|---|---|
| 73.4 | 1.00 | 1.00 |
| 80 | 0.88 | 0.93 |
| 90 | .75 | .81 |
| 100 | .62 | .70 |
| 110 | .50 | - |
| 120 | .4 | - |
| 130 | .3 | - |
| 140 | .22 | - |

NOTE: To obtain the pipe's reduced pressure rating because of water temperatures above 73.4 deg F, multiply normal pressure rating by the appropriate factor from table.

**d. Fittings and couplers**. All fittings and couplers shall meet or exceed the same strength requirements as those of the pipe and shall be made of material that is recommended for use with the pipe.

The ASTM standard specifications for fittings suitable for use with IPS-size pipe and inside diameter controlled PE pipe covered by this standard are:

ASTM - Standard specification for-

D-2466 - Socket-type Polyvinyl chloride (PVC) Plastic Pipe, Schedule 40;
D-2467 - Socket-type Polyvinyl chloride (PVC) Plastic Pipe, Schedule 80;
D-2468 - Socket-type Acrylonitrile-Butadiene-Styrene (ABS) Plastic Fittings, Schedule 40;
D-2609 - Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe;
D-2683 - Socket-type Polyethylene Fittings for SDR 11.0 Polyethylene Pipe;
D-3139 - Standard Specification for Plastic Pressure Pipe using Flexible Elastomeric Seals;
D-3261 - Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing;

Plastic pipe (PIP) shall have belled ends or separate couplers and fittings that are suitable for joining the pipe and appurtenances by solvent cement, rubber gaskets, or other methods recommended by the pipe manufacturer. Such fittings and joints shall be capable of withstanding a working pressure equal to or greater than that for the pipe.

**e. Solvent cement joints**. Solvent for solvent cement joints shall conform to ASTM Specification D-2564 for PVC pipe and fittings and to D-2235 for ABS pipe and fittings.

Solvent cement joints shall be used and constructed according to the recommendations of the pipe manufacturer.

**f. Rubber gasket joints**. Rubber gasket joints shall conform to ASTM Specification D-3139.

**g. Wall Thickness.** The wall thickness for all pipe installed under this standard, regardless of pressure rating or type, shall not be less than 0.060 inches.

**3. INSTALLATION**

**a. Minimum depth of cover.** Pipe shall be installed at sufficient depth below the ground surface to provide protection from hazards imposed by traffic crossings, farming operations, freezing temperatures, or soil cracking. The minimum depth of cover for pipe susceptible to any of these hazards shall be:

| Pipe Diameter (in.) | Depth of cover (in.) |
|---|---|
| ½ through 2 ½ | 18 |
| 3 through 5 | 24 |
| 6 or more | 30 |

In areas where the pipe will not be susceptible to freezing and vehicular or cultivation hazards and the soils do not crack appreciably when dry, the minimum depth of cover may be reduced to:

| Pipe Diameter (in.) | Depth of cover (in.) |
|---|---|
| ½ through 1 ½ | 6 |
| 2 through 3 | 12 |
| 4 through 6 | 18 |
| More than 6 | 24 |

The minimum cover for polyethylene pipe is 6 in but may be reduced to 2 in where conditions warrant. Rubber gasket joints may be used following normal bedding procedures where coarse sand or cement layers exist.

At low places on the ground surface, extra fill may be placed over the pipeline to provide the minimum depth of cover. The top width of the fill shall then be no less than 10 ft and the side

slopes no steeper than 6:1. If extra protection is needed at vehicle crossings, encasement pipe or other approved methods may be used.

**b. Trench construction**. The trench at any point below the top of the pipe shall be only wide enough to permit the pipe to be easily placed and joined and to allow the initial backfill material to be uniformly placed under the haunches and along the side of the pipe. The maximum trench width shall be 36 in greater than the diameter of the pipe. If the trench is precision excavated and has a semicircular bottom that closely fits the pipe, the width shall not exceed the outside diameter of the pipe by more than 10 percent.

The trench bottom shall be uniform so that the pipe lies on the bottom without bridging. Clods, rocks, and uneven spots that can damage the pipe or cause non-uniform support shall be removed.

If rocks, boulders, or any other material that can damage the pipe are encountered, the trench bottom shall be undercut a minimum of 4 in below final grade and filled with bedding material consisting of sand or compacted fine-grained soils.

Pipelines having a diameter of ½ through 2 ½ in that are to be placed in areas not subject to vehicular loads and in soils that do not crack appreciably when dry may be placed by using "plow-in" equipment instead of conventional trenching.

Provisions shall be made to insure safe working conditions where unstable soil, trench depth, or other conditions can be hazardous to personnel working in or near the trench.

**c. Placement.** Care shall be taken to prevent permanent distortion and damage when handling the pipe during unusually warm or cold weather. The pipe shall be allowed to come within a few degrees of the temperature it will have after it is completely covered before placing the backfill, other than that needed for shading, or before connecting the pipe to other facilities. The pipe shall be uniformly and continuously supported over its entire length on firm stable material. Blocking or mounding shall not be used to bring the pipe to final grade.

For pipe with bell joints, bell holes shall be excavated in the bedding material, as needed, to allow for unobstructed assembly of the joint and to permit the body of the pipe to be in contact with the bedding material throughout its length.

**d. Joints and connections.** All joints and connections shall be designed and constructed to withstand the design maximum working pressure for the pipeline without leakage and to leave the inside of the line free of any obstruction that may tend to reduce its capacity below design requirements.

All fittings, such as couplings, reducers, bends, tees, and crosses, shall be installed according to the recommendations of the pipe manufacturer.

Fittings made of steel or other metals susceptible to corrosion shall be adequately protected by being wrapped with plastic tape or by being coated with a substance that has high corrosion-preventative qualities. If plastic tape is used, all surfaces shall be thoroughly cleaned and coated with a primer compatible with the tape before wrapping.

**e. Thrust blocks.** Thrust blocks must be formed against a solid hand-excavated trench wall undamaged by mechanical equipment. They shall be constructed of concrete, and the space between the pipe and trench wall shall be filled to the height of the outside diameter of the pipe or as specified by the manufacturer.

**f. Testing.** The pipeline shall be tested for pressure strength, leakage, and proper functioning. The tests may be performed before backfilling or anytime after the pipeline is ready for service.

Tests for pressure strength and leaks shall be accomplished by inspecting the pipeline and appurtenances while the maximum working pressure is maintained and all joints and connections are uncovered, or by observing normal operation of the pipeline after it is put into service. Partial backfills needed to hold the pipe in place during testing shall be placed as specified in "Initial Backfill." Any leaks shall be repaired and the system retested.

The pipeline shall be tested to insure that it functions properly at design capacity. At or below design capacity there shall be no objectionable flow conditions. Objectionable flow conditions shall include water hammer,

continuing unsteady delivery of water, damage to the pipeline, or detrimental discharge from control valves.

**g. Initial backfill.** Hand, mechanical, or water packing methods may be used.

The initial backfill material shall be soil or sand that is free from rocks or stones larger than 1 in. in diameter. At the time of placement, the moisture content of the material shall be such that the required degree of compaction can be obtained with the backfill method to be used. The initial backfill material shall be placed so that the pipe will not be displaced, excessively deformed, or damaged.

If backfilling is done by hand or mechanical means, the initial fill shall be compacted firmly around and above the pipe as required to provide adequate lateral support to the pipe. If the water packing method is used, the pipeline first shall be filled with water. The initial backfill before wetting shall be of sufficient depth to insure complete coverage of the pipe after consolidation. Water packing is accomplished by adding enough water to diked reaches of the trench to thoroughly saturate the initial backfill without excessive pooling. After the backfill is saturated, the pipeline shall remain full until after the final backfill is made. The wetted fill shall be allowed to dry until firm before beginning the final backfill.

**h. Final backfill.** The final backfill material shall be free of large rocks, frozen clods, and other debris greater than 3 in. in diameter. The material shall be placed and spread in approximately uniform layers so that there will be no unfilled spaces in the backfill and the backfill will be level with the natural ground or at the design grade required to provide the minimum depth of cover after settlement. Rolling equipment shall not be used to consolidate the final backfill until the specified minimum depth of cover has been placed.

All special backfilling requirements of the pipe manufacturer shall be met.

**i. Basis of acceptance.** The acceptability of the pipeline shall be determined by inspections to check compliance with all the provisions of this standard with respect to the design of the line, the pipe and pipe marking, the appurtenances, and the minimum installation requirements.

**j. Certifications and guarantee.** If requested by the state conservation engineer, a qualified testing laboratory must certify with supporting test results that the pipe meets the requirements specified in this standard. The seal of approval of a recognized laboratory on pipe bearing one of the ASTM designations listed in this standard may be accepted for this certification.

The installing contractor shall certify that his or her installation complies with the requirements of this standard. He or she shall furnish a written guarantee that protects the owner against defective workmanship and materials for not less than 1 year. The certification identifies the manufacturer and markings of the pipe used.

## 4. OPERATION AND MAINTENANCE PLAN

A properly operated and maintained irrigation pipeline is an asset to a farming operation. When federal funds are used to pay for this practice, it must be maintained for a period of 25 years. The estimated life span of this installation can be assured and usually increased by developing and carrying out a good operation and maintenance program.

The following are some recommendations to help develop an operation and maintenance program.

- Check to make sure all valves and air vents are set at the proper operating condition so they may provide protection to the pipeline.
- Maintain the design depth of cover over the pipeline.
- Limit traffic over the pipeline to designated sections that were designed for traffic loads and avoid travel over pipelines by tillage equipment when the soil is saturated.
- Avoid any sub-soiling operation that may disturb the pipeline.
- Remove all foreign debris that hinders system operation.
- Drain the system and components in areas that are subject to freezing.
- Eradicate or otherwise remove all rodents or burrowing animals. Immediately repair any damage caused by their activity.

- Allow adequate time to fill the pipe gradually.
- Periodically check and repair all valves, gates, vents, inlets, and outlets to the pipe system to ensure proper operation.
- Immediately repair any vandalism, vehicular, livestock, or other damage to any outlets and appurtenances.